SECTION VI

SURFACE WATER MANAGEMENT PLAN

AECOM

SURFACE WATER MANAGEMENT PLAN
WAIMANALO GULCH SANITARY LANDFILL
KAPOLEI, O`AHU, HAWAI`I

Prepared for:
Waste Management of Hawaii
92-460 Farrington Highway
Kapolei, O`ahu, Hawai`i 96707

Prepared by:
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August 31, 2009

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APPENDIXES

FIGURES

ACRONYMS AND ABBREVIATIONS

°F	degree Fahrenheit
BMP	best management practice
CCH	City and County of Honolulu
CMP	corrugated metal pipe
CWA	Clean Water Act
DOH	Department of Health, State of Hawai`i
HAR	Hawai`i Administrative Rules
msl	mean sea level
MSW	municipal solid waste
NPDES	National Pollutant Discharge Elimination System
NGPC	Notice of General Permit Coverage
SPCC	Spill Prevention, Control, and Countermeasures
SWPCP	Storm Water Pollution Control Plan
SWMP	Surface Water Management Plan
U.S.	United States
WGSL	Waimanalo Gulch Sanitary Landfill
WMH	Waste Management of Hawai`i, Inc.
WMI	Waste Management, Inc.

1.0 INTRODUCTION

This Surface Water Management Plan (SWMP) was prepared for the Waimanalo Gulch Sanitary Landfill (WGSL), located at 92-460 Farrington Highway, in Kapolei, O`ahu, Hawai`i. The WGSL is owned by the City and County of Honolulu (CCH) and operated by Waste Management of Hawai`i, Inc. (WMH), a subsidiary of Waste Management, Inc. (WMI). This SWMP was prepared in accordance with Hawai`i Administrative Rules (HAR) Title 11, Chapter 58.1, and Special Conditions III of the WGSL solid waste permit (No. LF-0054-02), dated May 15, 2003, issued by the Solid and Hazardous Waste Branch of the Hawai`i Department of Health (DOH).

1.1 PURPOSE OF SURFACE WATER MANAGEMENT PLAN

The purpose of the SWMP is to describe and ensure the implementation of surface water management practices that prevent run-on and control run-off from a 25-year, 24-hour storm event. The WGSL solid waste permit specifies the following requirements:

- Prevention of run-on and collection and control of run-off from a 25-year, 24-hour storm;
- Prevention of soil erosion and exposure of waste due to soil erosion; and
- Prevention of a discharge of pollutants into waters of the United States (U.S.), or violation of any requirement of the Clean Water Act (CWA) or statewide water quality management plan.

The SWMP is updated annually to address any new flow patterns that may have resulted due to municipal solid waste (MSW) landfilling operations and to verify the adequacy of the on-site drainage measures.

1.2 REGULATORY BACKGROUND

1.2.1 Solid Waste Regulations

Solid waste regulation HAR 11-58.1-15(g) provides requirements to ensure adequate control of storm water events at landfills. The regulation requirements for run-on or run-off control systems and surface water management are listed below.

Requirements for run-on or run-off control systems

- Owners or operators of all MSW landfill units must design, construct, and maintain the following:
  - A run-on control system to prevent flow onto the active portion of the landfill during the peak discharge from a 25-year storm.
  - A run-off control system from the active portion of the landfill to collect and control at least the water volume resulting from a 24-hour, 25-year storm.
- Run-off from the active portion of the landfill unit must be handled in accordance with surface water requirements.

Requirements for surface water management

- MSW landfill units shall not:
  - Cause a discharge of pollutants into waters of the U.S., including wetlands, that violates any requirement of the CWA, including, but not limited to, the National Pollutant Discharge Elimination System (NPDES) requirements, pursuant to Section 402 of the CWA.

- Cause the discharge of a non-point source of pollution to waters of the U.S., including wetlands, that violates any requirement of an area-wide or state-wide water quality management plan that has been approved under Sections 208 or 319 of the CWA, as amended.

1.2.2 National Pollutant Discharge Elimination System

The CCH was issued a Notice of General Permit Coverage (NGPC) for the WGSL under NPDES on March 2, 2005, which was assigned File No. HI R50A533. Under the WGSL's NGPC, the CCH, Department of Environmental Services is authorized to discharge storm water run-off associated with industrial activity at the WGSL to the receiving State water named the Pacific Ocean, a Class A Marine Water, at coordinates 21º00′04″N and 158º07′35″W. The activities associated with the WGSL NGPC are described in the WGSL Storm Water Pollution Control Plan (SWPCP), which was written to comply with this regulation and was originally submitted to the Clean Water Branch of the DOH in 2005. The SWPCP is evaluated as often as needed to comply with the condition of the NGPC and is included in the Site Operations Manual (WMH 2007) that was previously submitted to DOH.

The SWPCP was updated in 2008 to reflect on-site changes (Earth Tech 2008) and re-submitted to DOH. Spill Prevention, Control, and Countermeasures Plan.

A Spill Prevention, Control, and Countermeasures (SPCC) Plan was developed for the WGSL and is included in the Site Operations Manual (WMH 2007) that was previously submitted to DOH. The SPCC Plan complies with Title 40 Code of Federal Regulations Part 112 and addresses measures for prevention and control of fuel and oil related spills.

2.0 SITE BACKGROUND

This section presents a summary description of the WGSL including its location, size, elevation, and limits, and surrounding area.

2.1 SITE DESCRIPTION

The WGSL is located at 92-460 Farrington Highway in Kapolei, on the southwest side of the island of O`ahu, Hawai`i. The site is approximately 15 miles northwest of Honolulu International Airport and two miles southeast of Nanakuli, as shown on Figure 2-1. The facility occupies a portion of a rugged, southwest-sloping coastal canyon (Waimanalo Gulch) and extends approximately 1.2 miles up-canyon (northeast) from Farrington Highway. The landfill office and scale house are located at the southern end of the facility, near Farrington Highway. The site location is shown on Figure 2-2.

The WGSL property encompasses a total of 198.6 acres. The site is long and narrow, approximately 7,000 feet in length, with a width ranging from 820 feet on the Farrington Highway frontage to about 1,900 feet at the widest point. The landfill entrance at Farrington Highway is approximately 60 feet above mean sea level (msl), and the extreme northeast corner of the property is at an elevation of 990 feet above msl. The natural terrain of the WGSL slopes upward from approximately 8 percent at the lower end, to approximately 18 percent at the upper end of the property.

Currently, 78.9 acres of the property are permitted for landfill activities, of which, approximately 58.9 acres are designated for non-hazardous municipal solid waste (MSW) disposal and 20 acres are designated and developed as a monofill for the disposal of non-hazardous MSW incinerator ash (combustion residue) from the Honolulu Program of Waste to Energy Recovery (H-Power) plant. The ash monofill occupies the lower (southern) portion of the WGSL, while the MSW unit occupies the topographically higher (northern) portion of the site.

2.2 CLIMATE AND TOPOGRAPHY

The WGSL is located in a region of O`ahu that is relatively arid when compared to the rest of the island due to the “rain-shadow” effect of the Waianae Mountain Range. Average annual rainfall in the area is approximately 20 inches, while stations in nearby mountains experience significantly higher rainfall averages (Hokuloa gauge, elevation 2,200 msl, average annual rainfall 42 inches).

Prevailing winds in the area of the landfill are the Hawaiian tradewinds, which are channeled along the Nanakuli coastline by the Waianae and Ko`olau Mountains, in a roughly southeast to northwest direction, at an average annual speed of approximately 10 knots. Between the months of October and April, the WGSL occasionally comes under the influence of southerly winds associated with Kona storms or approaching storm fronts.

Typical daily temperatures range from the low 60s (degrees Fahrenheit [°F]) to the upper 70s (°F) during the winter and from the lower 70s (°F) to the upper 80s (°F) during the summer.

The regional topography near the WGSL is dominated by the moderate to steep Waianae Range, a northerly trending volcanic mountain range that is characterized by narrow valleys, separated by steeply sloping hills and ridges. The range extends northward from the site approximately 20 miles and is up to approximately 4 miles in width. The WGSL is located at the southern toe of this range in a typically steep and narrow valley (gulch). Elevations along the main mountain ridgeline range from about 1,000 to 3,600 feet msl. Elevations drop dramatically away from the main ridgeline. Lateral slopes along the Waianae Range are asymmetrical, with steeper slopes to the west. Typical slopes on the sides of the range drop some 2,600 feet over distances of two miles or less. Near the WGSL, the mountains of the Waianae Range transition to the low-lying coastal plains. Elevations abruptly diminish from 2,300 feet msl (Pu`u Manawahua) to sea level in a lateral distance of two miles in the WGSL vicinity (RUST September 1993).

2.3 SURROUNDING AREA

The WGSL is surrounded by rugged terrain and open space to the north and west. The Hawaiian Electric Kahe Power Generating Station is located west of the WGSL's boundary, with the nearest structure being over 900 feet distant. The Ko `Olina Resort is just south of the landfill, across Farrington Highway from the main entrance of the facility. Thirteen residential land parcels are located southwest of the WGSL, approximately 500 feet from the southernmost edge of the landfill footprint.

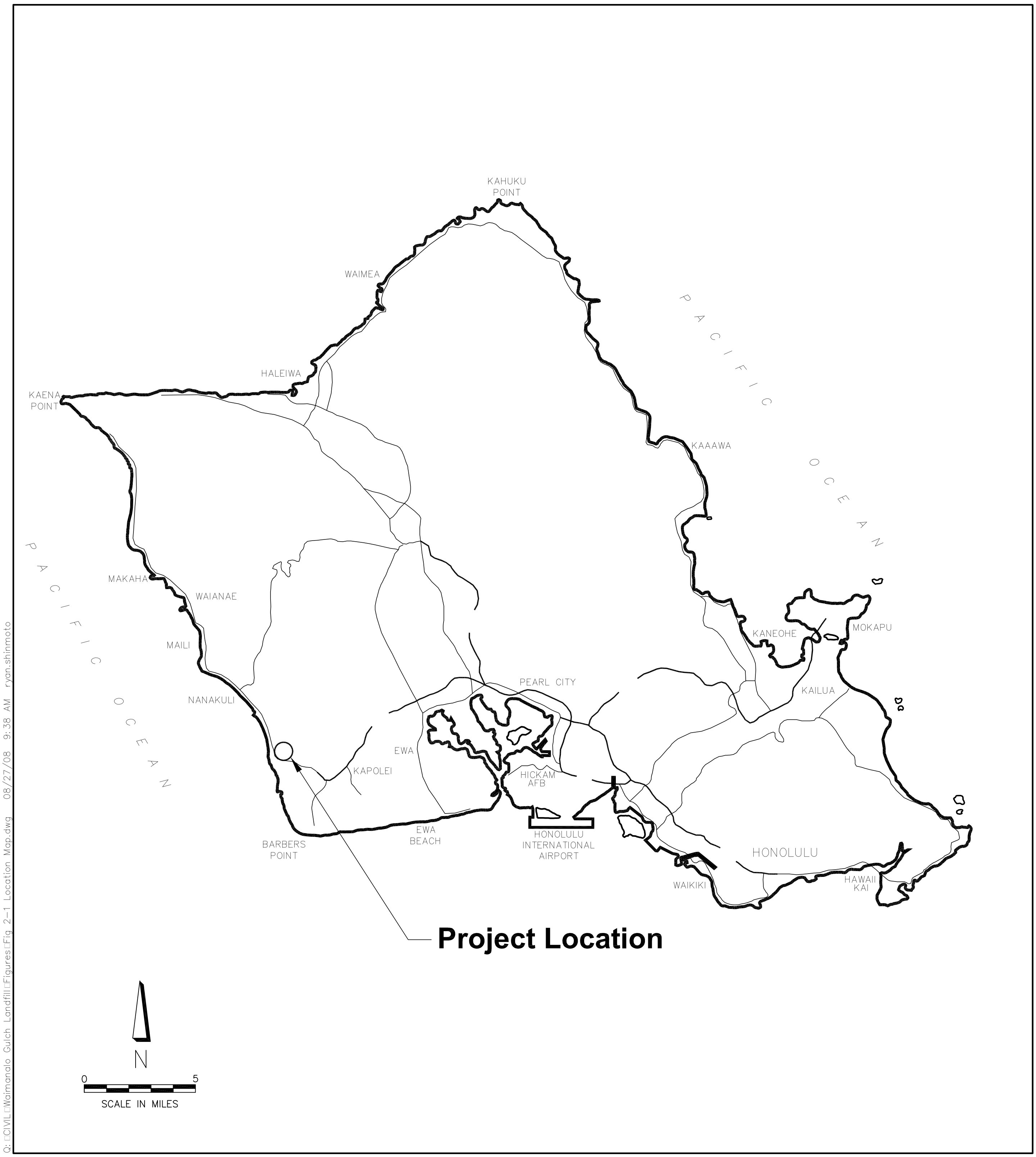

Figure 2-1
Project Location Map
Waimanalo Gulch Sanitary Landfill
Kapolei, O`ahu, Hawai`i

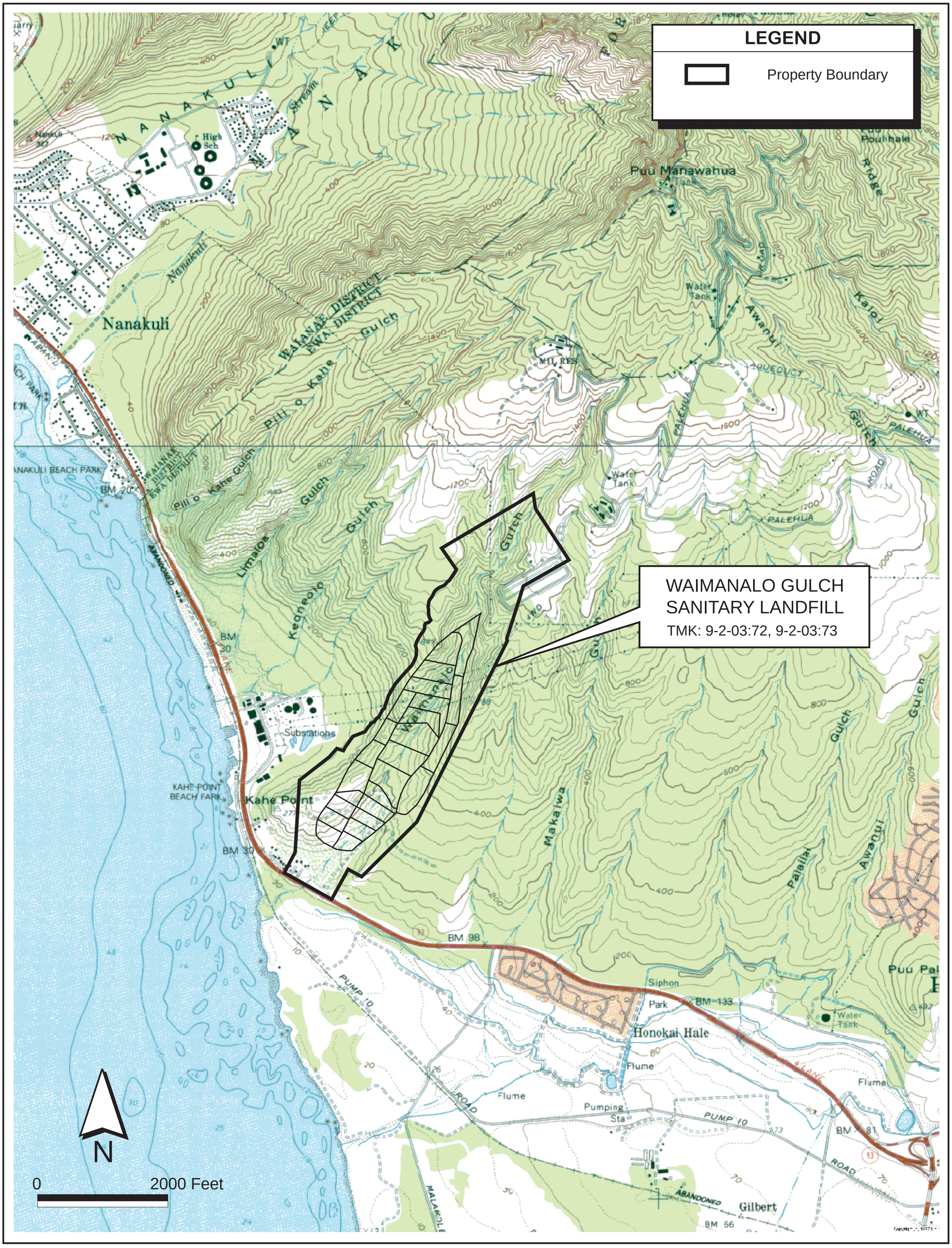

Figure 2-2
Site Location Map
Waimanalo Gulch Sanitary Landfill
Kapolei, O`ahu, Hawai`i

3.0 SURFACE WATER MANAGEMENT PLAN INSPECTION AND MEASURES

This section describes the existing surface water management features at the WGSL, presents the results of the annual inspection, evaluates the effectiveness of the surface water drainage system by reviewing and updating supporting hydrology/hydraulics calculations, and provides recommendations for additional measures necessary to provide adequate drainage control.

3.1 EXISTING DRAINAGE AND EROSION CONTROL FEATURES

In 2006, WMH constructed a comprehensive on-site storm drainage system to convey the landfill run-off flows from a 25-year, 24-hour storm. Since 2006 to present, site drainage features have been updated. Figure 3-1A and Figure 3-1B illustrates the current site drainage features based on the most recent topographic map for the site (March 2009). .

3.1.1 Main Haul Road Swale and Downdrains

The drainage swales are rock-lined to reduce surface run-off velocities and to increase sediment control. The existing drainage swales convey surface water run-off from the upper areas of the landfill adequately. Down-drain pipes are installed at appropriate intervals to convey swale flows down to the western concrete-lined drainage channel. Gravel check dams remain in place at the drainage inlet locations to reduce flow velocities and potential over-flow along the length of the drainage swale.

3.1.2 Slopes

The south facing slope above the main haul road was hydroseeded in 2006 and has grass established for erosion control. Because a portion of these areas have not yet fully established, these areas will be re-hydroseeded this year. A silt fence was installed against the chain link fence which borders the eastern edge of the western perimeter concrete-lined channel. This silt fence acts as a secondary erosion control measure should excessive flow from the slopes overtop the silt fence at the toe of slope. The silt fence consists of woven geotextile held in-place with steel rebar posts and backfilled with coarse gravel along the up-slope side of the fence. The geosynthetic tarps that were placed on the slopes above the Main Haul Road were removed due to re-grading of portions of the landfill. These newly graded slopes were hydroseeded in early 2009. This will greatly reduce sediment accumulation in the concrete-lined drainage channel. The geosynthetic tarps are still in place on the slopes below the Main Haul Road.

3.1.3 Swales and Detention Pond

For the remainder of the site, concentrated on-site flows are conveyed via a series of rock-lined swales and pipes that ultimately drain into the western concrete-lined drainage channel and then into the detention pond, which is located near the facility entrance. The detention pond has a 30-foot-long energy dissipater at the outfall of the western concrete channel consisting of 18-inch to 24-inch rocks. A rip-rap berm is also located within the detention pond and detains initial storm water run-off entering the pond in a pre-holding area, thus reducing the amount of sediments and particulates that will reach the 48-inch reinforced concrete pipe inlet risers. Subdrains are located within the pond to minimize standing water conditions during low flow events.

3.1.4 West Berm

The 2003 expansion plan for the landfill required the construction of a soil stabilization berm (west berm) along the northwestern perimeter of the landfill, which consequently covered (filled in) a portion of the existing western drainage channel. In 2006, two temporary 48-inch corrugated metal pipes (CMP) were installed in the western drainage channel to accommodate up-canyon surface water, which flows down the drainage channel. The pipes convey run-off generated from the canyon area above the landfill. These pipes will be abandoned after the west berm construction is completed and the western drainage channel is realigned further to the west. These two temporary 48-inch diameter CMP pipes carry run-off beneath the west structural fill berm into the lower reach of the channel and down to the detention pond located at the southwestern corner of the site.

A temporary berm was constructed along the western boundary of the site, adjacent to the proposed west berm to ensure surface water from the upstream drainage basins would be intercepted and conveyed to the existing detention pond downstream.

3.1.5 Detention Pond Discharge

Stormwater discharging from the 2 – 42 inch discharge pipes, from the detention pond, flows for approximately 200 feet through a well vegetated grassy area prior to leaving the site. Multiple geosynthetic bags approximately four feet in length and six inches in diameter, filled with gravel and small size rock, as well as groupings of large size rocks were installed below the discharge pipes to allow stormwater to spread throughout the grassed area before discharging off site. This additional dispersion provides passive stormwater treatment enhancement with further sediment removal and further improved discharge water quality.

3.2 Evaluation of Drainage Measures

A site inspection was performed by AECOM on August 21, 2009 to determine the condition of the existing drainage system features and erosion and sediment controls. The annual site inspection log is presented in Appendix A.

Dormant vegetation was observed in several areas on the interim cover, but this is expected during dry summer conditions. Some slopes previously hydroseeded will be reseeded. These areas are identified on Figure 3-1A and Figure 3-1B. The rock line swales along the main haul road were observed to have a slight lip along the upslope edge that appeared to reduce surface water from flowing directly into the swale.

In order to confirm that the existing drainage measures are adequate, a review of last year's hydrology and hydraulic calculations was performed. On-site hydrology calculations (see Appendix B) were performed for the 25-year, 24-hour storm in order to properly size drainage swales and piping. The 25-year, 24-hour rainfall interpolation of O`ahu (Giambelluca et al. 1984) was used to determine rainfall intensity. The Technical Release-55 method (USDA 1986) was used to determine the 25-year, 24-hour storm run-off peak flow rates. The sizing analysis for the current drainage features was completed in the 2006 SWMP (Earth Tech 2006). The majority of the drainage basins have not significantly changed; therefore, estimated peak discharges and sizing of hydraulic features from last year's report remain valid (see Appendix B). Due to changes in topography from the slope grading and MSW filling that have occurred in the landfill, some drainage patterns have changed slightly. New hydrologic calculations were performed for these areas and are presented in Appendix B. Recommendations for additional drainage measures are provided below.

3.3 Recommended Measures

The following measures are recommended for surface water management at the WGSL.

3.3.1 Detention Pond

WMH plans to route run-on flows from the watershed above the landfill via a lined channel (western perimeter channel) that will bypass the lower detention pond. Therefore, only surface water from the landfill footprint will flow into the detention pond. With construction of the new western perimeter channel and minor modifications to the outlet risers, the pond will be able to achieve flood control and water quality design criteria for a 25-year, 24-hour storm. The bypass channel and pond performance are discussed further in a technical memorandum by Geosyntec Consultants, Inc. presented in Appendix C.

3.3.2 Eastern and Western Perimeter

WMH has produced engineering drawings and calculations for permanent solutions to both the east side and west side drainage areas of the landfill. The west side improvement will involve the construction of a hydraulically sized trapezoidal concrete-lined channel that will pick up up-canyon drainage. The solution for the east side will replace the existing swale with hydraulically sized drainage pipes or open channels to convey all surface water originating from the eastern portion of the site down to the detention pond. Construction is tentatively planned for both the east side and west side drainage in 2010.

3.3.3 Maintenance Measures

The following maintenance measures are to be implemented:

- As necessary, fiber rolls or silt fences will be placed along the top of banks along exposed active work areas to reduce erosion and sediment loss due to storm water sheet flow.
- Installation of wattles or similar best management practices (BMP) along larger slope faces (greater than 15 feet in height) to reduce surface runoff velocities, downstream sediment activity and to promote vegetative establishment.

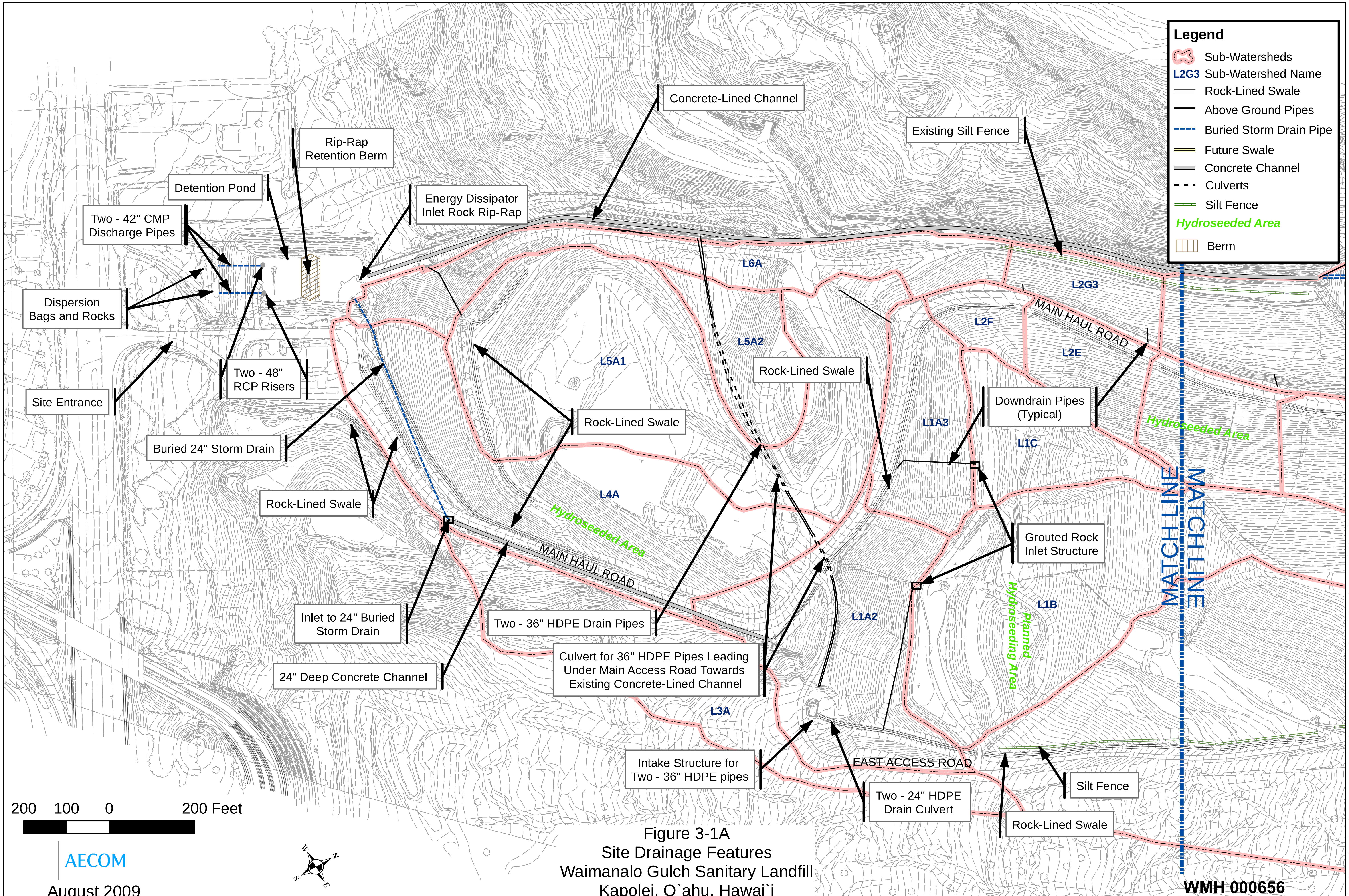

Figure 3-1A
Site Drainage Features
Waimanalo Gulch Sanitary Landfill
Kapolei, O`ahu, Hawai`i

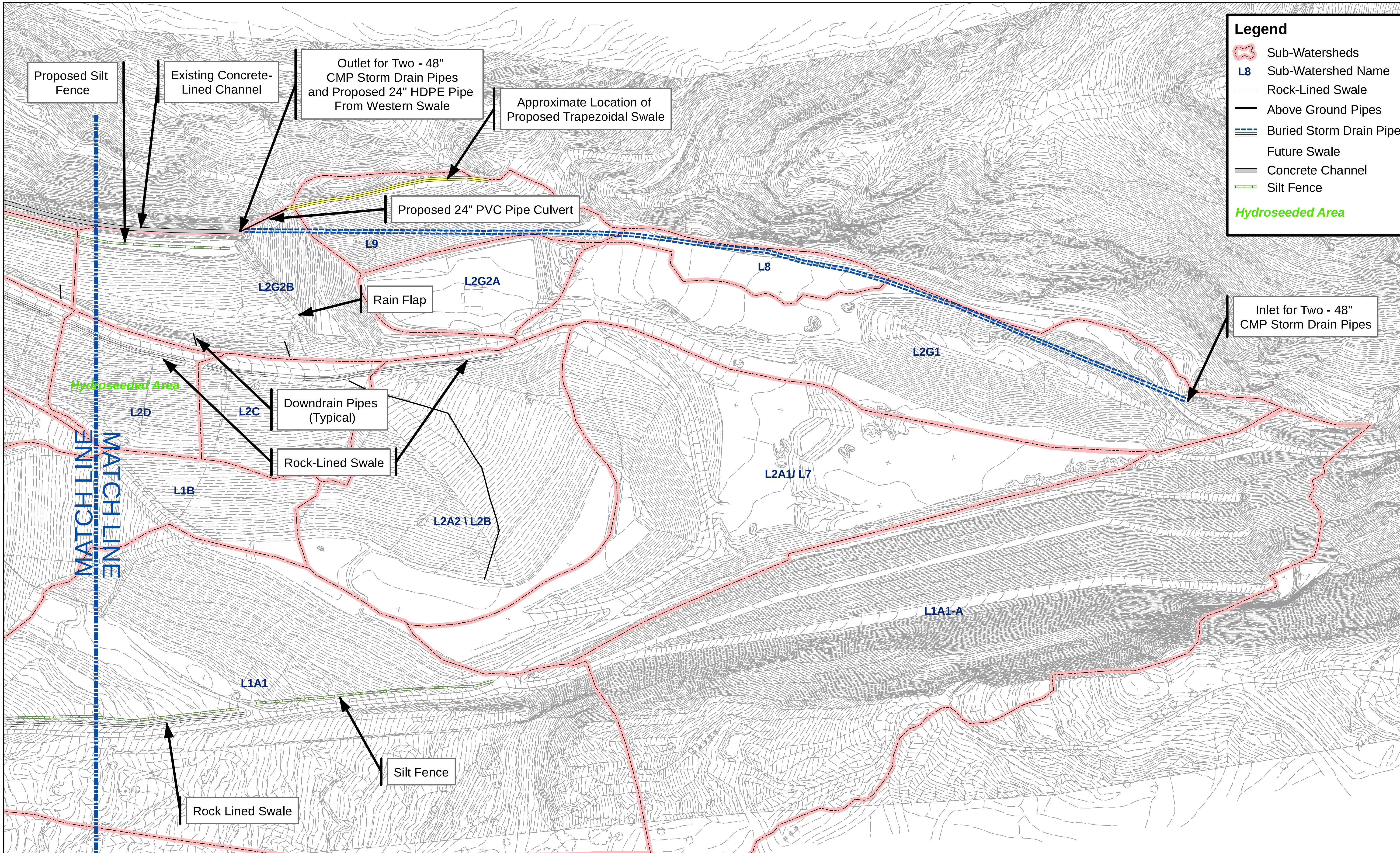

Figure 3-1B
Site Drainage Features
Waimanalo Gulch Sanitary Landfill
Kapolei, O`ahu, Hawai`i

August 2009

WMH 000658

4.0 SWMP IMPLEMENTATION AND EVALUATION

This section describes the mechanisms and procedures through which the SWMP will be implemented and evaluated. It identifies the required inspections and follow-up actions and record keeping procedures.

4.1 SWMP IMPLEMENTATION

4.1.1 Inspections

Annual inspections of the landfill area, the drainage system, and the detention pond are performed by WMH personnel. An inspection log sheet is used to document the results of the inspection. The current annual inspection log sheet is presented in Appendix A. After all major rain storm events, inspections of the drainage system, detention pond, and erosion and sediment measures are performed to identify failures, breaches, or sediment deposition requiring repair.

4.1.2 Record Keeping

Records of the inspections and follow-up actions are maintained in the WGSL Operating Record/Files.

4.2 SWMP EVALUATION

The effectiveness of the WGSL storm water run-on and run-off drainage systems is reviewed on an annual basis. The review assesses the drainage pond, new flow patterns due to changes in grades, the effectiveness of the employed erosion and sediment control BMPs, and compliance with the procedural requirements of the SWMP (inspection, reporting, record keeping, and SWMP updates).

The effectiveness of individual BMPs is assessed using visual observations made during the annual inspections. The inspection log form is used to document the effectiveness and appropriateness of the existing erosion and sediment control measures and drainage system features for current site conditions. Maintenance of the detention pond is scheduled on an annual basis and includes removal of any sediment deposits within the detention pond bottom.

4.2.1 Documentation of Revisions

Changes to the SWMP are incorporated through updates of plans and the SWMP. Revisions are reflected within the update log located in Appendix D including the revision date and a brief description of changes.

5.0 REFERENCES

Autodesk, Civil Design 2005, Version 2005.0.0, Service Pack 1.

Earth Tech, Inc. 2006.*Storm Water Pollution Control Plan, Waimanalo Gulch Sanitary Landfill, O`ahu, Hawai`i.* September.

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Giambelluca, T. W., L. S. Lau, Yu-Si Fok, and T. A. Schroeder. 1984. *Rainfall Frequency Study for O`ahu*. Report R73: State of Hawaii Department of Land and Natural Resources, Division of Water and Land Development. Honolulu.

United States Department of Agriculture (USDA). Natural Resources Conservation Service 1986. *Urban Hydrology for Small Watersheds, Technical Release 55 (TR-55),* Revised June.

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Waste Management of Hawaii, Inc. (WMH) 2007. *Site Operations Manual, Waimanalo Gulch Sanitary Landfill, Kapolei, Hawai`i. Volumes I and II.* August.

Appendix A
Annual Site Inspection Log Sheet

ANNUAL INSPECTION LOG
WAIMANALO GULCH SANITARY LANDFILL
SURFACE WATER MANAGEMENT PLAN

GENERAL INFORMATION

Date: 8/21/2009

Personnel: Justin Lottig and Jeff Impens

Weather:

Raining	Yes ☐	No ☒		
Time Since Last Rainfall Event	Rain event of 0.87 inches on 8/12/09			

Runoff:

Flow observed?	Yes ☐	No ☒		
Type of Flow	Sheet ☐	Rill ☐	Concentrated	☐

VISUAL OBSERVATIONS

Inspection List	Yes/No/NA	If Yes, Describe Location and Required Follow-up Action (if any)
Active Face / Landfill Cover		
Bare or sparsely vegetated areas	No	Active Face- No vegetation, bare areas Landfill Cover- Vegetation scattered throughout. WMH in process of hydroseeding select areas.
Settlement or depressions	No	
Slope Instability	No	
Gullies caused by erosion	No	Slight erosion on barren areas WMH in the process of regarding and erosion control material placement.
Illicitly-dumped material	No	
Stressed or dead vegetation	No	
Other indicators of leachate seepage	No	
Drainage swales		
Evidence of erosion	No	Rock lines swales present throughout site performing properly.
Sediment deposition	No	
Detention Pond		
Structure blocked or has obstructions	No	
Outfall areas eroded	No	

WMH 000666

Inspection List	Yes/No/NA	If Yes, Describe Location and Required Follow-up Action (if any)
Security Measures		
Landfill access road gate damaged	No	
Access Roads		
Roads inaccessible	No	
Roads damaged by erosion or settlement	No	
Leachate Sumps		
Depth from top of sump less than 3 feet?	N/A	
Side Slopes Covered with Geosynthetic Tarps		
Evidence of erosion?	No	
Geosynthetic tarps intact on lower slopes?	Yes	
Geosynthetic tarp condition on lower slopes?	Ok	
Side Slopes hydroseeded?		
Upper slopes hydroseeded?	No	Slopes need to be hydroseeded to establish vegetation. WMH in process of hydroseeding.

WMH 000667

Appendix B
SWMP Onsite Hydrology & Hydraulic Calculations

ONSITE HYDROLOGY CALCULATION

The analysis follows the Technical Release-55 (TR-55) Urban Hydrology for Small Watersheds method (USDA 1986) to determine the 25-year, 24-hour storm run-off peak flow rates. Where applicable in the drainage sub-watersheds, weighted run-off coefficients were calculated for composite drainage areas. Time of concentration or time of travel for each sub-watershed and reach was determined using run-off coefficients as given in TR-55 for the various existing site surface conditions. Surface run-off peak flows were determined from the 25-year, 24-hour rainfall map of O`ahu (USDC 1962).

The delineated watershed boundaries are shown on Figure B-1. The boundaries and surface conditions for the 17 sub-watersheds listed in Table B-1 have not changed or had an insignificant change since the last Surface Water Management Plan update last year in 2008.

Table B-1: Sub-watersheds with insignificant change from previous year delineation

Sub-Watershed Name	2009 Basin Area (Acres)	2008 Basin Area (Acres)	Difference (2009-2008)
L1A1	19.05	19.05	0.00
L1A1-A	17.65	17.65	0.00
L1A2	4.97	4.97	0.00
L1A3	2.31	2.31	0.00
L1B	8.23	8.23	0.00
L1C	2.12	2.12	0.00
L2C	2.11	2.11	0.00
L2D	1.91	1.91	0.00
L2E	1.51	1.51	0.00
L2F	0.77	0.77	0.00
L2G2A	1.84	1.84	0.00
L2G2B	4.22	4.22	0.00
L2G3	1.18	1.18	0.00
L3A	4.78	4.78	0.00
L4A	7.13	7.13	0.00
L6A	3.36	3.36	0.00
L9	2.36	2.36	0.00

The outfall peak discharges from all of the sub-watersheds listed in Table B-1 are in accordance with last year's modeling. The sub-watershed time of concentrations, values, run-off coefficients, and drainage areas remained comparatively the same and therefore had no significant effect on the outfall peak discharges. All of the on-site drainage features such as the piped drainage systems, rock-lined and rip-rap swales, and the piped culverts have been working properly on site within the past year. These features are designed to convey surface water run-off to the detention pond while minimizing erosion and sediment dispersal and are doing a sufficient job of containing surface water run-off.

The six sub-watersheds listed in Table B-2 showed a significant change from previous year conditions due to active landfill cell filling operations that caused changes in surface topography and drainage pattern. The changes were inferred from latest topographic survey maps and recent site visit assessment of the onsite drainage features. These sub-watersheds were all evaluated using TR-55 to find their 25-year, 24-hour storm run-off peak flow rates. Adjustments to the sub-watershed delineation resulted in the increase delineated areas for L2A2/L2B, L2G1, and L5A1. Correspondingly, areas for L2A1/L7, L5A2, and L8, were reduced because water from parts of these sub-watersheds are now flowing to adjoining sub-watersheds (i.e. L2A2/L2B, L2G1, and L5A1).

Table B-2: Sub-watersheds with significant changes in topography

Sub-Watershed Name	2009 Basin Area (Acres)	2008 Basin Area (Acres)	Difference (2009-2008)	New Peak flow (ft^3/sec.)	Old Peak flow (ft^3/sec.)	Difference (Old-New)
L2A1/L7	10.33	15.86	-5.53	51.95	81.93	-29.98
L2A2/L2B	7.40	4.86	+2.54	35.22	21.21	+14.01
L2G1	7.75	4.06	+3.69	37.76	20.96	+16.8
L5A1	9.14	8.41	+0.73	47.21	43.44	+3.77
L5A2	1.75	2.39	-0.64	7.38	10.08	-2.7
L8	1.08	1.50	-0.42	5.59	7.74	-2.15

As seen from Table B-2 the changes in Peak flow between current year and previous years is primarily related to changes in sub-watershed areas. Flows increased in sub-watersheds where new delineations resulted in an increase in area and flow decreased in sub-watersheds where delineations resulted in a smaller area. There is a net increase of 0.37 acres in the delineation because a small area was added to the onsite areas in sub-watershed L2G1. However, the net peak flow for the sub-watersheds affected by changes in topography and drainage pattern reduced by 0.25 cubic feet per second (cfs) in comparison to peak flows from the same area watershed basin in previous years. This decrease is related to changes in time of concentration for the sub-watersheds because of longer flow paths and changes in slope where water is flowing. Because of this decrease there will be no additional flow to manage on-site.

REFERENCES

United States Department of Agriculture (USDA). Natural Resources Conservation Service 1986. *Urban Hydrology for Small Watersheds, Technical Release 55 (TR-55),* Revised June.

United States Department of Commerce (USDC). Weather Bureau. 1962. *Technical Paper No. 43, Rainfall-Frequency Atlas of the Hawaiian Islands, for Areas to 200 Square Miles, Durations to 24 Hours, and Return Periods from 1 to 100 Years, Washington, D.C. 2.*

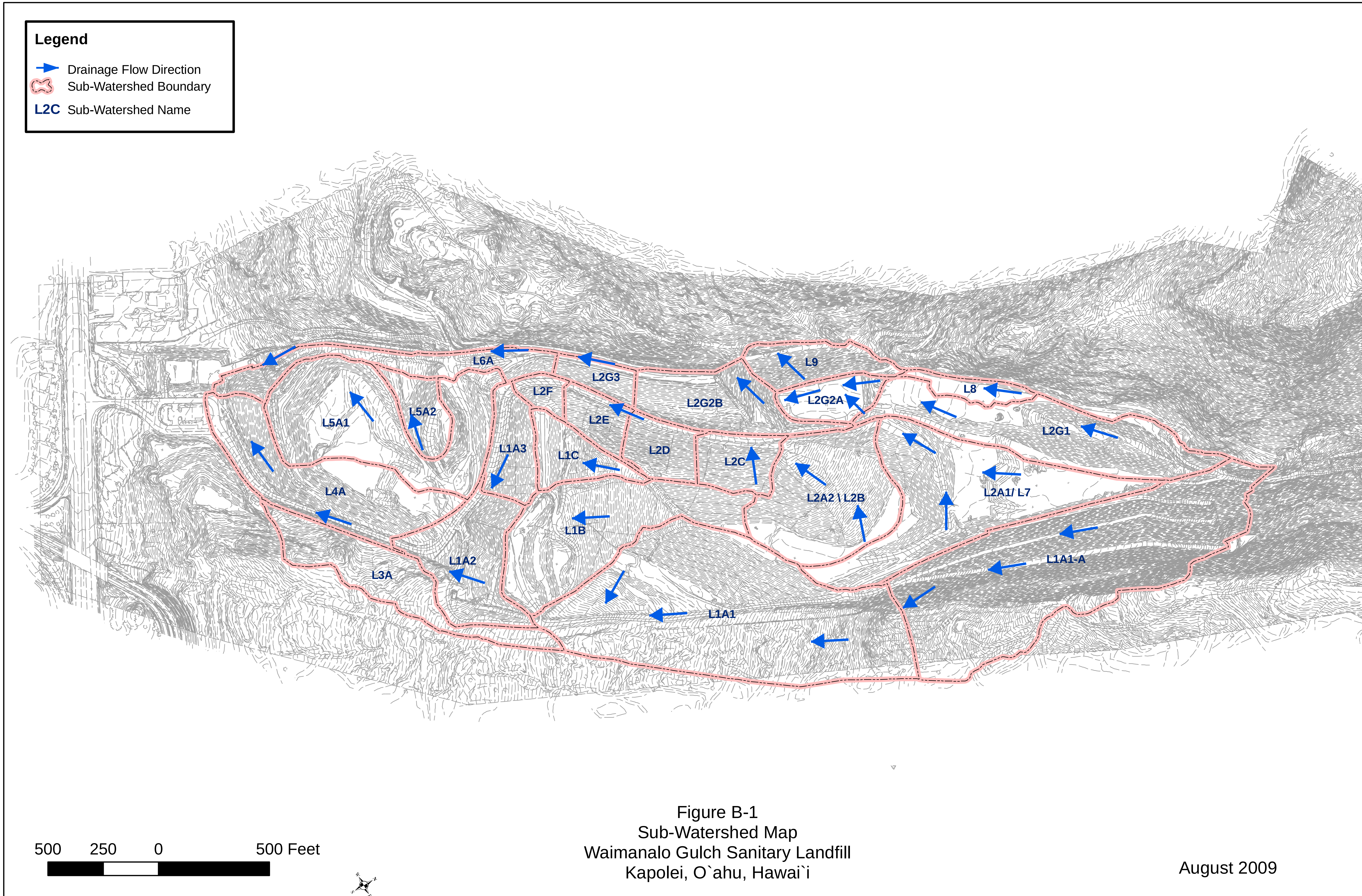

Figure B-1
Sub-Watershed Map
Waimanalo Gulch Sanitary Landfill
Kapolei, O`ahu, Hawai`i

August 2009

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Appendix C
Technical Memorandum for Sedimentation Pond

GEOSYNTEC CONSULTANTS, INC.
TECHNICAL MEMORANDUM

TO: RICK VON PEIN, PE (WASTE MANAGEMENT, INC.)

FROM: HARI SHARMA, GARY PALHEGYI, FABRIZIO SETTEPANI

SUBJECT: **SYNOPSIS OF SEDIMENTION POND PERFORMANCE**

DATE: 14 AUGUST 2007

Question 11 asks about the performance of the existing sedimentation basin; its overall volume, flow through velocities, and particle settling performance. This brief technical memorandum summarizes our response.

The existing sedimentation basin was designed based on flood control criteria; however, current regulations require that the sedimentation basin also be designed based on water quality criteria. The required water quality criteria are specified in the City and County of Honolulu's *Storm Drainage Standards* (2000). The main difference between the criteria is that the design storage volume is computed using a different formula and the holding time increases from about 6 hours to 48 hours to achieve the required settling performance.

Design for Flood Control

The existing sedimentation basin was designed according to flood control criteria (Earth Tech 2005) such that it detained and slowly released the 25-year, 24-hour design storm through the riser pipes; the estimated detention time is 6 hours. The basin can also safely pass the 100-year peak discharge through the spillway without flooding. The basin currently has two 48-inch diameter perforated riser pipes to control stormwater for storms up to the 25-year event, and has a rock weir and spillway to pass storm flows greater than the 25-year design storm.

To provide a frame of reference, Earth Tech (2005) computed the total existing basin storage and back calculated the storm that fits this volume, arriving at the 25-year, 2-hour event. The basin was not originally designed to this criterion.

Water Quality Design Volume

In 2006, Geosyntec evaluated the sedimentation basin design and water quality requirements based on the *Storm Drainage Standards* and determined that the existing basin did not meet the water quality design criterion. This is primarily due to capturing Run-On from the upper watershed. To address this issue, Waste Management plans to re-route Run-On from the upper watershed around the landfill via a lined channel (Western Perimeter Channel) and bypass the sedimentation basin. The bypass channel is currently being designed by GEI Consultants, Inc.

Once the Western Perimeter Channel is constructed; only landfill surfaces and minor adjacent side slopes will drain to the sedimentation basin; therefore, only minor modification will be required to meet the water quality design criterion. The criterion requires the volume to be computed as shown below; furthermore, the basin should detain the computed volume for 48 hours to achieve the required settling time and water quality performance.

According to the *Storm Drainage Standards,* the water quality design volume (WQDV) is computed using:

WQDV = C x 1” x A x 3630

where:

C = runoff coefficient
1” = 1 inch of rainfall over the entire catchment
A = Area of catchment
3630 = unit conversion

Table 1 summarizes the estimated water quality design volume as well as the additional excavation volume needed to accommodate the WQDV for the landfill portion of the Run-On after the Western Perimeter Channel has been constructed.

Table 1 – Water Quality Design Volumes

Volume Required	Area	C	Rainfall	Volume
	(acres)		(inches)	(cubic-feet)
Option 1	165	0.5	1	299500
Option 2	162	0.5	1	293300
Existing Basin[1]				309276
Excavation Needed				0

Option 1 includes a small area of off-site run-on from the south-western portion of the watershed that could pass over the proposed pipe section of the western perimeter channel. Option 2 assumes that ALL of the off-site areas west of the perimeter channel is

[1] The existing basin volume was reported by Earth Tech in November 2005 *Surface Water Management Plan, Waimanalo Gulch Sanitary Landfill, Kapolei, Oahu, Hawaii*. In September 2006, Earth Tech again reports an existing volume of 7.1 acre-feet or 309,276 cubic-feet with a new basin configuration and outlet design.

captured as clean water and routed around the sedimentation basin. The difference is actually minor and there is enough volume in the existing basin to satisfy either case.

One of the other changes that will be implemented by WM is to increase the drain time of the basin from 6 hours to 48 hours to meet the water quality requirements. This will require modification of the outlet structure low flow orifice openings to slow the rate of discharge of smaller volumes. The figures attached show examples of outlets designed for a different project with similar goals.

This modification will affect the effectiveness of the basin at managing the 25-year and 100-year, 24-hour storms. WM plans to make the necessary modifications in basin design to satisfy both the water quality and flood control performance.

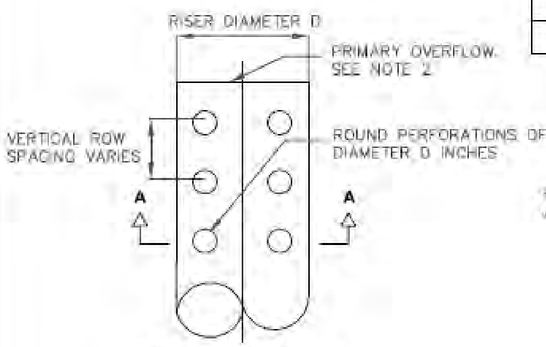
References

City and County of Honolulu. 2000. *Rules Relating to Storm Drainage Standards*.

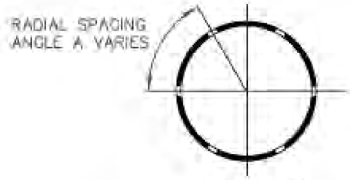
Earth Tech, Inc. 2005. *Surface Water Management Plan, Waimanalo Gulch Sanitary Landfill, Oahu*.

Smooth Plastic Riser Standard Dimensions (Wyoming NRCS)

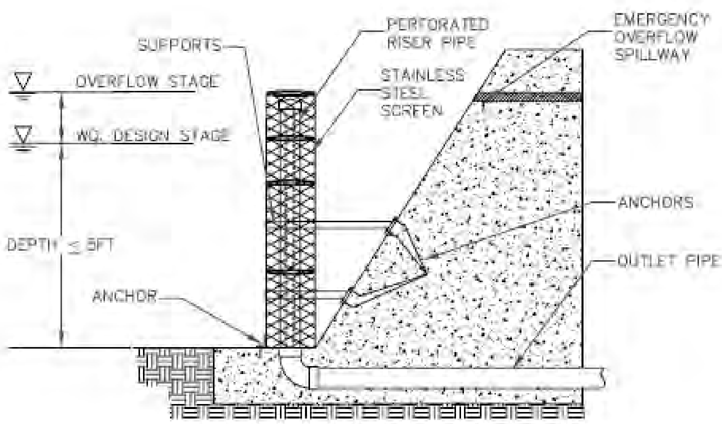
Max Orifice Diameter D (inches)	Pipe Diameter (inches)	Min Wall Thickness (inches)	No. of vertical rows of perforations	Radial Spacing of Vertical Rows A (Degrees)
$3\frac{1}{2}$	8	0.15	6	60
$6\frac{5}{8}$	10	0.20	8	38
8	12	0.25	10	45



Perforated Riser Detail
(Not to Scale)



Section A-A
(Not to Scale)



Perforated Riser Outlet Structure
(Not to Scale)

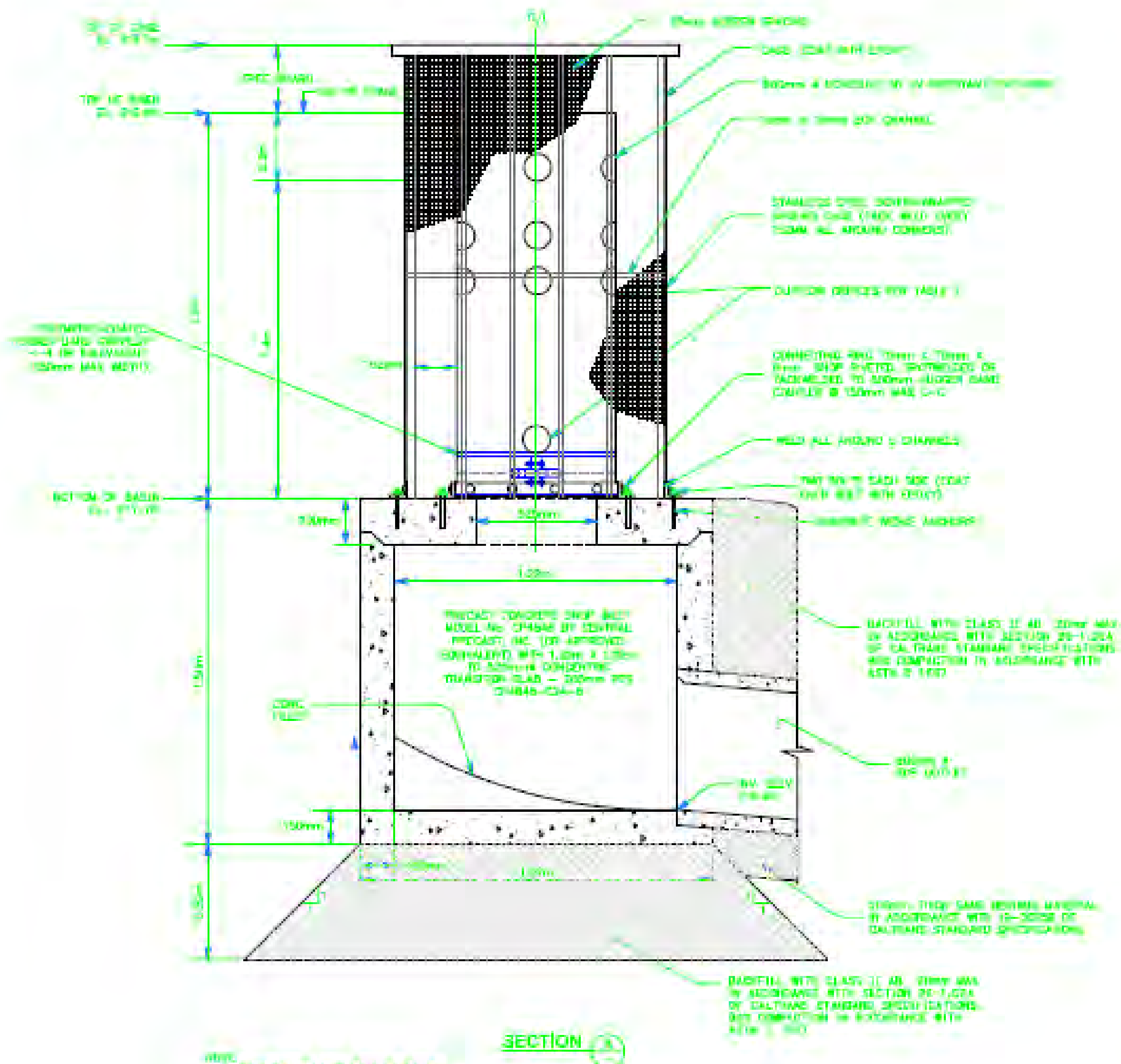
NOTES:

1. RISER PIPE SHALL BE SIZED TO PROVIDE 36 TO 48-HOUR FULL BRIM DRAW DOWN TIME.
2. TOTAL OUTLET CAPACITY: CAPITAL DEVELOPED PEAK FLOW FOR ON-LINE BASINS AND WATER QUALITY DESIGN FLOW FOR OFF-LINE BASINS.
3. SCREEN OPENINGS SHALL BE AT LEAST $\frac{1}{8}$" AND SHALL NOT EXCEED THE DIAMETER OF THE PERFORATIONS ON THE RISER.
4. MINIMUM NUMBER OF PERFORATIONS SHALL BE 8.
5. MINIMUM DIAMETER SHALL BE ½".
6. MAXIMUM PERFORATION DIAMETER SHALL BE 2".

GEOSYNTEC CONSULTANTS

Figure 2-2

PERFORATE RISER OUTLET



RISER OUTLET STRUCTURE/
PRIMARY OVERFLOW SPILLWAY

NO SCALE

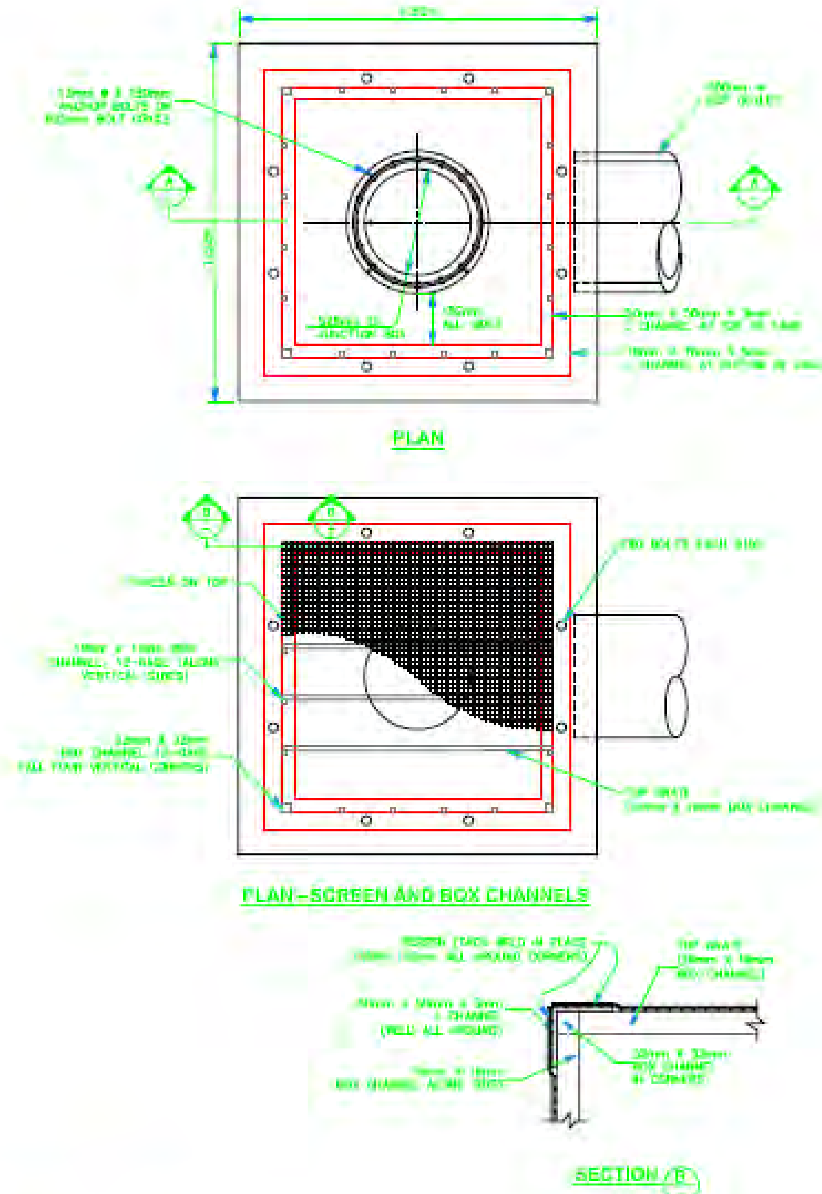


Table 1 ORIFICE SCHEDULE	
ELEVATION (m)	ORIFICE mm (COUNT O.C.)
219.70	TOP OF BASIN
219.40	TOP OF RISER
219.10	75 (8)
218.30	75 (8)
218.80	75 (8)
217.90	44.4 (1)
217.70	BOTTOM OF BASIN

ALAMEDA COUNTY Metric

COUNTY OF ALAMEDA ☆ PUBLIC WORKS AGENCY

THE RELOCATION OF VASCO ROAD
FROM THE VICINITY OF MILEPOSTS 3.0 TO 4.3
WATER QUALITY AND
HYDROMODIFICATION BASIN
OUTLET STRUCTURE

REVISIONS

R23265

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OF

U-357-6

WMH 000682

Appendix D
Update Log

UPDATE LOG
WAIMANALO GULCH SANITARY LANDFILL
SURFACE WATER MANAGEMENT PLAN

DATE	DESCRIPTION OF UPDATE	NAME/SIGNATURE OF RESPONSIBLE OFFICIAL
September 2006	The original SWMP prepared in November 2005 has been updated to reflect current site conditions including the current aerial view (Figures 2-3 & 2-4), updated on-site drainage measures plans (Appendix A), the updated hydrology and hydraulic calculations (Appendix B), and the overall watershed hydrology calculations (Appendix C). The SWPCP has been excluded from this version of the SWMP and will be submitted to DOH separately. In addition the 2006 Annual Inspection documentation has been included in Appendix E.	
August 2007	The SWMP has been updated from 2006 to reflect all construction of drainage measures completed to date. Figure 3-1A and Figure 3-1B have been updated with the most current topography (March 2007) as well as new drainage features. Surface water hydrology and hydraulic calculations were updated to reflect the changed conditions (Appendix C). The SWPCP and SPCC are both included in the Site Operations Manual that was submitted to DOH, so therefore they are not included in this SWMP.	
August 2008	The SWMP has been updated to reflect the most recent topographic conditions (May 2008) and site drainage features updated during 2007. Figure 3-1A and Figure 3-1B have been updated with the most current topography (May 2008). Also surface water hydrology and hydraulic calculations were updated to reflect the changed conditions (Appendix B). The SWPCP and SPCC are both included in the Site Operations Manual that was submitted to DOH, so therefore they are not included in this SWMP.	
August 2009	The SWMP has been updated to reflect the most recent topographic conditions (March 2009) and updated site drainage features. Figure 3-1A and Figure 3-1B have been updated with the most current topography (March 2009). Also surface water hydrology and hydraulic calculations were updated to reflect the changed conditions (Appendix B). The SWPCP and SPCC are both included in the Site Operations Manual that was submitted to DOH, so therefore they are not included in this SWMP.	